



COMSATS University, Islamabad

Islamabad Campus

Department of Computer Science
TERMINAL EXAMINATION - SPRING 2023

Class: BS(CS/SE/AI/DS)

Subject: Data Structure and Algorithm

Time Allowed: 90 mins

Instructors: Dr. Inayat Ur-Rehman/ Mr. Mustafa Khattak/ Dr. Zobia Rehman/ Dr. Nusrat
Shaheen/ Mr. Syed Ahmed

Date: May 08, 2023

Total Marks: 50

Section: CS-3B

Registration Number: SP22-BCS-053

QUESTION 1: ===== CLO-1: Employ linear data structures to solve computing problems. ===== Marks: 20

Case study 1: A major transport company wants to implement an advanced online seat reservation system. The company operates between Islamabad and Karachi, having stops/terminals in six major cities (say Mianwali, Bhakkar, Multan, Bahawalpur, Sukhar, and Hyderabad). The buses leave from main terminals at 9:00 am, 12noon and 9 pm. Clients/passengers may request to reserve a maximum of four seats against a single request, however, the passenger with maximum number of seats request will be given higher priority (like if a person a requests 4 seats other person requests 3 seats then 4 will be of higher priority). Requests may be cancelled or changed any time before confirmation without any penalty. However, after confirmation (1 hour before leaving) 25% penalty will be imposed. The seating capacity of a bus is 40. Seats will be allocated based on FCFS keeping in view the following quota.

- First 15 seats are reserved for starting to ending terminal (Karachi-Islamabad, Islamabad-Karachi).
- Next 10 seats are reserved for starting terminal to 2nd last terminal.
- Next 5 seats are reserved for starting terminal to 3rd last terminal.
- Next 4 seats are reserved for starting terminal to 4th last terminal.
- Next 3 seats are reserved for starting terminal to 5th last terminal.
- Next 2 seats are reserved for starting terminal to 6th last terminal.
- Last seat is reserved for starting terminal to 7th last terminal.

Following rules will also be applicable:

- A waiting queue will be maintained for each terminal.
- Request of last terminal will be of higher priority then n-1th terminal.
- Requests for N seats will be preferred over the requests for N-1 and so on.
- In case sufficient requests are not available as per quota specified above, next higher level requests will be entertained to fill up the seats.
- Waiting requests will automatically be promoted to the next higher level if they are not entertained from the last two hours.

To efficiently implement the above case scenario, suggest a suitable combination of data structures by:

- What Data Structures you will prefer to do for which specific task elaborate with conceptual diagram. [4 Marks]
- Write the structure with required data members/global variables along with their types. [4 Marks]
- Write the pseudocode/C language code of required functions (ADT) along with their pre-conditions and post-conditions. [12 Marks]

QUESTION 2: ===== CLO-1 ===== Marks: 15

Assume that you have already implemented the ADT Stack. By using that (don't reinvent the wheel), write a program to implement the Priority Queue by using stack.

QUESTION 3: == CLO-2: Use non-linear data structures to solve computing problems. Marks:15 (7.5+7.5)

Part-1: Write an optimally efficient algorithm to find the successor (next greater value of node) of a given node n in a BST.

Part-2: Using the above defined method, write an algorithm for deleting a node d from BST when neither of d 's subtrees is empty. There may be a case when there is a right subtree of successor.